Earth Science Technology Office (ESTO)

Performance Metrics

May 8, 2001

Performance Metrics Legend

- (Blue) Significantly exceeded the performance goal.
- (Green) Met the performance goal.
- (Yellow) Performance goal was not fully met, progress was significant and achievement is anticipated within the next fiscal year.
- (Red) Performance goal not met, achievement is not anticipated in the next fiscal year, or may not be achievable.

Performance Metrics- ESTP/NMP/HPCC-ESS

		NOT MET	MET	EXCEEDED
*1. At least twenty-five (25) percent of funded development tasks advance by at least one technology readiness level (TRL) each year.	E N H	○	○	●
*2. Annual transfer of at least one (1) technology development to a commercial entity; infusion into a remote sensing or in situ mission; or infusion into the information systems development.	E N H	○	○	○ In Process
3. Annually establish at least one joint agreement with a program external to NASA, or within NASA, but external to ESE, that results in the inclusion of at least one (1) ESE technology requirement.	E	○	○	●
4. Technology funding strategy that results in at least 25% of TRL 5-6 and no more than 20% TRL 1-2, annually.	E	●	○	
5. Annual update of the data/information residing in the Technology Integrated Planning System(TIPS) by ESTO and the Agency-level Technology Inventory.	E N H	○	●	
6. Perform at least one annual update of the Integrated Technology Development Plan by ESTO	E N H	○	●	
7. Annual update of the Capability Needs for Science, Applications and Technology (CN-SAT) based on the currently approved Science and Applications Requirements	E	○	●	

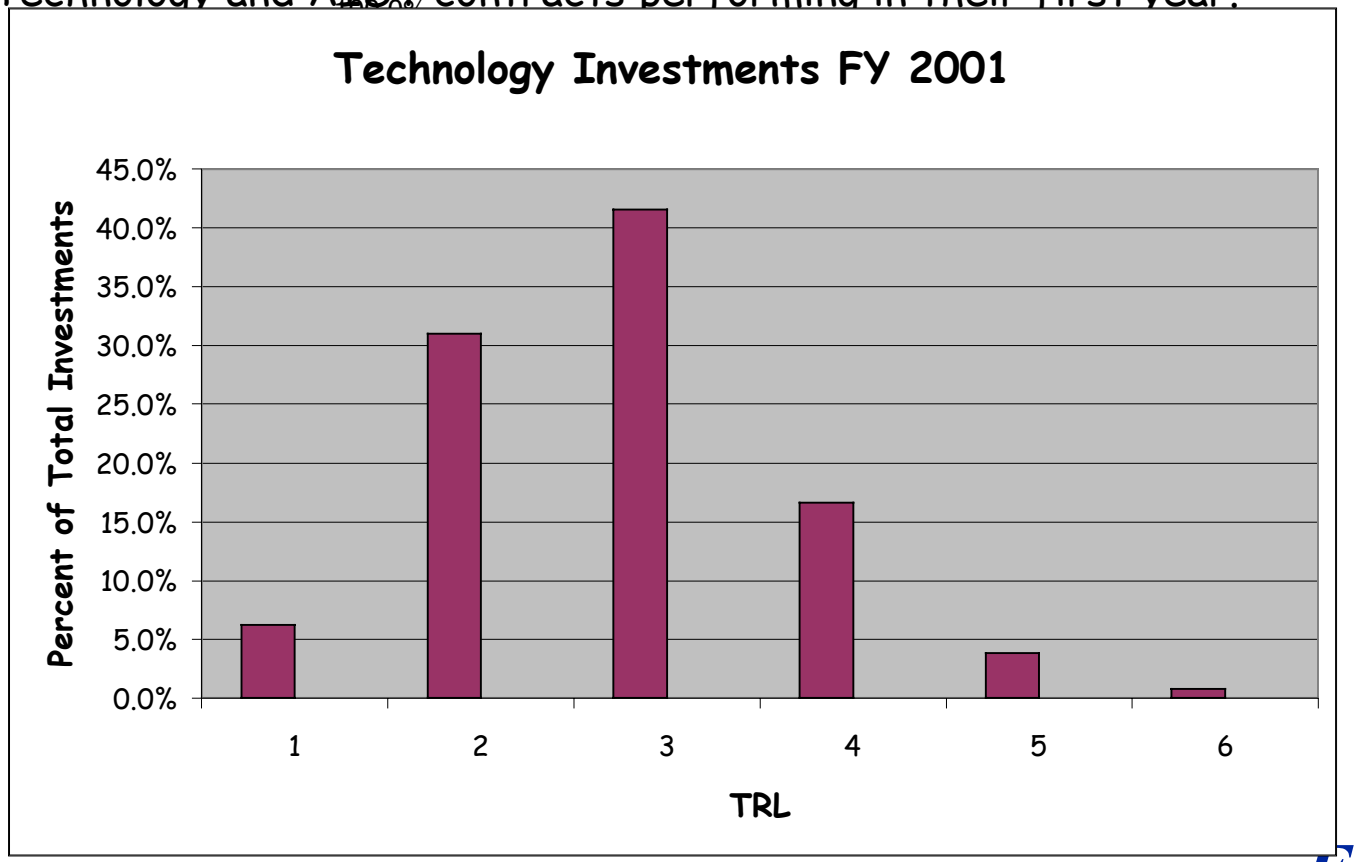
Performance Metrics- ESTP/NMP/HPCC-ESS

1. **9 of 26 (35%) IIP advanced at least 1 TRL in FY '01**
   - Degnan, GSFC TRL 4->5
   - Whiteman, GSFC TRL 4->5
   - Diner, JPL TRL 4->5
   - Herman, Univ. of Ariz. TRL 3->4
   - Boncyk, JPL TRL 3->4
   - Njoku, JPL TRL 3->4
   - Lambrigtsen, JPL TRL 4->5
   - Lichten, JPL TRL 2->3
   - Zawodny, LaRC TRL 4->5
3. **Partnerships**
   - Joint Study (matching funds) with SBTP High Data Rate Delivery Thrust area to study communications architectures and requirements for constellations. Study to also include distributing the computational resources among the vehicles.
   - Joint effort with Code M (HQ), SOMO Technology program and GRC to add enhanced capabilities to SOMO Lower Power Transceiver (LPT). Capabilities to be added, include: ungraded processors, S-band cross-links, and a Cisco mini-router. This joint effort also leverages the ESTO AIST NRA award to ITT to develop enhancements to the LPT for increased radiation (SEU) tolerance.

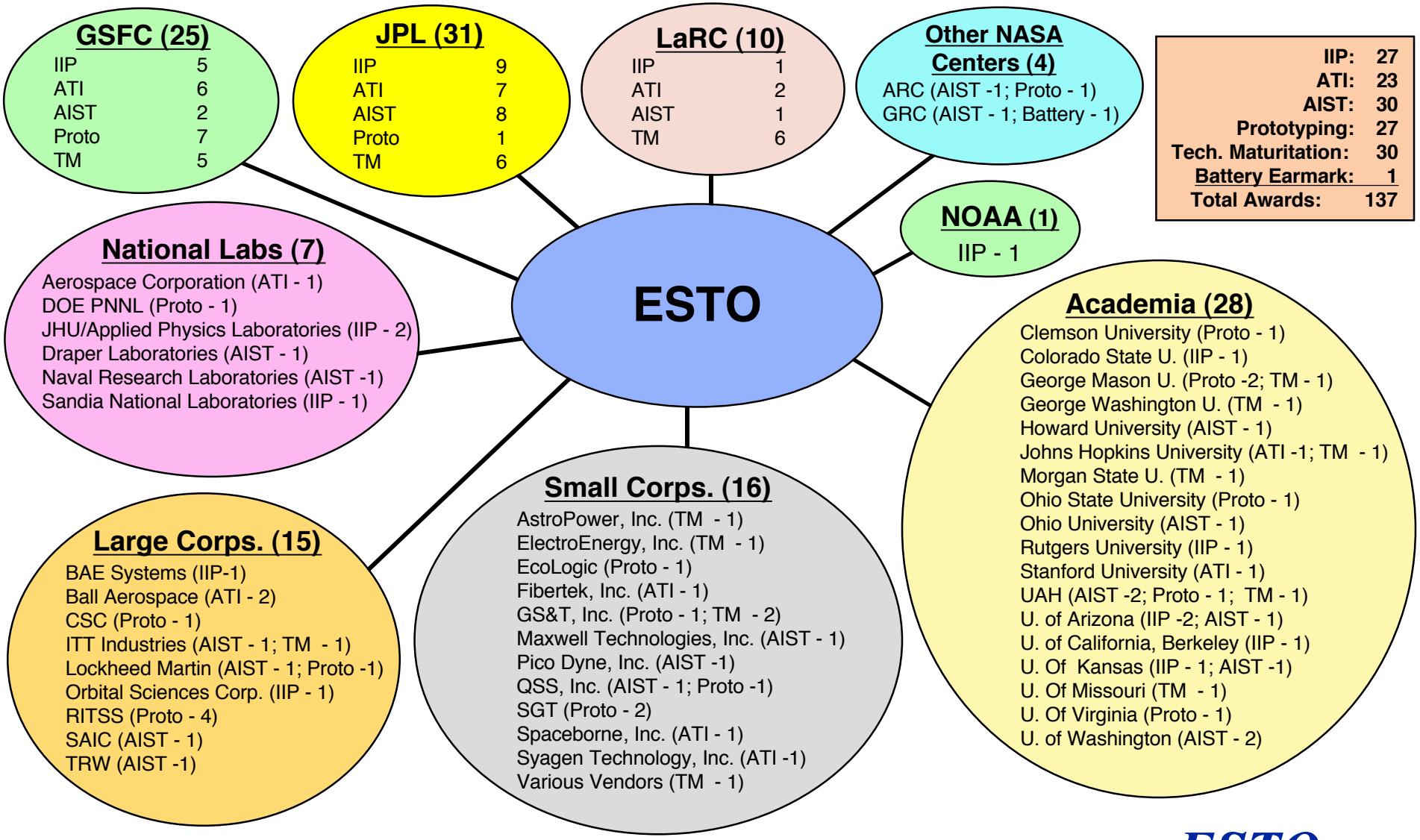
Performance Metrics- ESTP/NMP/HPCC-ESS

4. ESTO Technology Funding for 2001

- The performance metric is yellow. The program is still maturing with IIP Phase 1 contracts having finished their second year and ATI Component Technology and AIST contracts performing in their first year.



ESTO Technology Investments



Enterprise Metrics: Success Stories

NPOESS Preparatory Project

ESTO-supported technologies for infusion into NPP In-Situ Terminal:

1. Digital Demodulator ASIC (see next slide) is key technology component in digital receiver board. ESTO-funded ASIC final design and initial foundry run of chips which are now used in the operating board.

2. Reconfigurable Computing Application Development Environment (RCADE) tools evolved *directly* from ESTO Prototyping Program[1]:

   - Allows rapid integration of ESE data processing algorithms into FPGAs.

   - Testing of FPGA processing using Terra MODIS data has already begun. Major bottleneck is re-programming the FPGAs when the algorithms are updated.

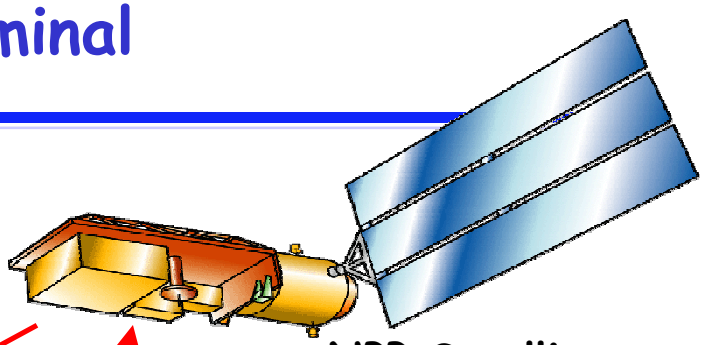
   - ESTO tool-set is designed to address this *exact* problem.

1. "Scalable Remote Sensing Applications" which is a Parallel Problem Solving Environment (PSE) for Remote Sensing and Telemetry Processing.

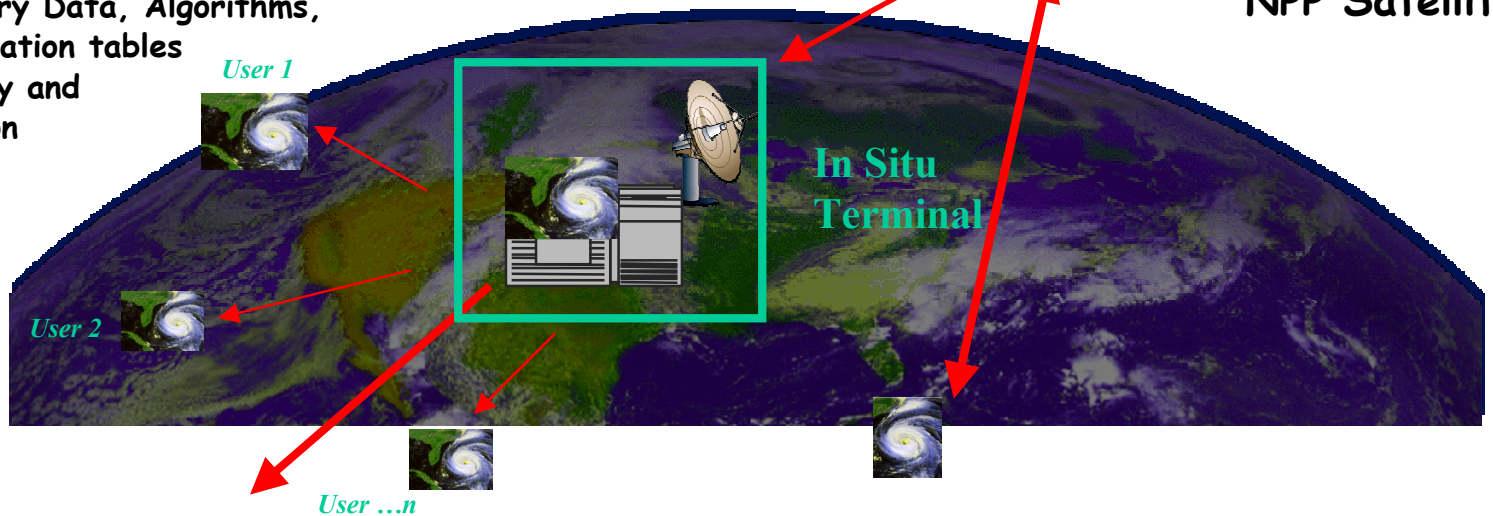
NPP In-Situ User Terminal

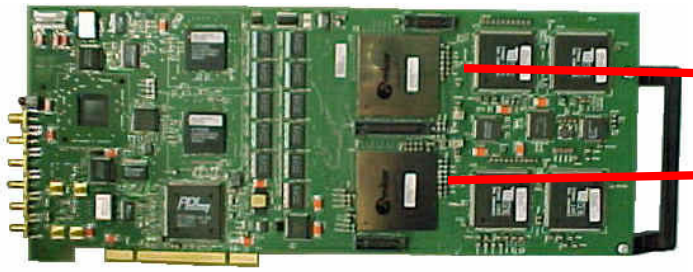
Features:

- High rate front end
  - RF processing; CCSDS packet processing; Data capture
- Data processing and archive environment
- Level 1B, higher level products
  - Ancillary Data, Algorithms, Calibration tables
- Product query and distribution

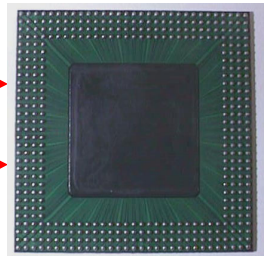


NPP Satellite





NPP Digital Receiver Board



ESTO Digital De-Modulator ASIC

Precise Global Real-time Onboard Navigation Capability For Earth Science Remote Sensing

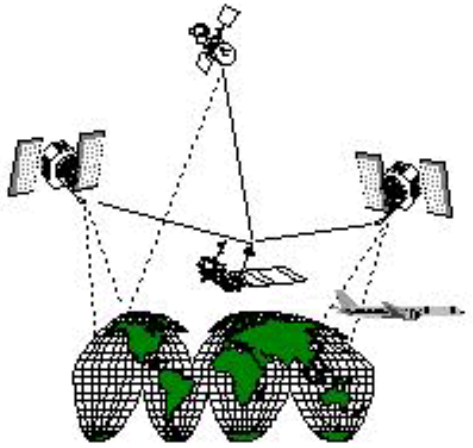
PI: Yoaz Bar-Sever / JPL

Description and Objectives

Develop GPS-based technology that will enable:

- Ultra-precise real-time orbit determination
- Global uniform coverage extending into space
- Autonomous navigation

Demonstrate an end-to-end NASA global differential system and its scientific benefits



Approach

Extend JPL's Wide Area GPS differential Technology to a global scale

Develop end-user hardware and software to enable autonomous navigation

Leverage NASA's GPS infrastructure and commercial capabilities to demonstrate a global differential GPS service

Application/Mission

Timely monitoring and response to natural hazards (e.g., SAR, AirSAR)

Intelligent, cooperating sensor webs in Earth orbit

Precise and secure navigation (e.g., RLV)

Prototype for Mars Network

Current Payoff

(NavCom, Inc., a subsidiary of John Deere), has signed an agreement to provide correction data….

System status

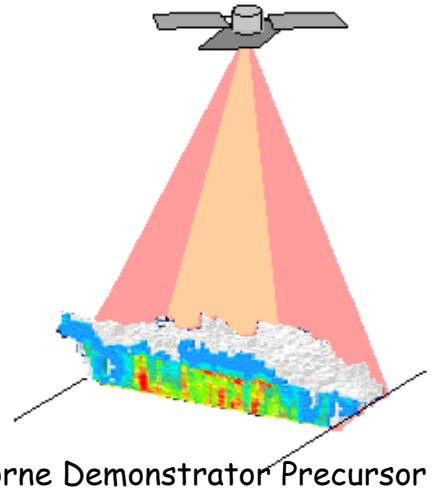
- We have a signal. A "beta" signal is now available over North and South America for test and characterization, using a global beam of an Inmarsat Satellite.
- Preliminary tests show the signal is received clearly in North America. The signal is based on the corrections to the GPS orbits and clocks generated at JPL.

A Second generation Spaceborne Precipitation Radar

Characteristics

Dual-frequency to improve dynamic range and sensitivity on rain measurements (TRMM radar has 1 frequency)

- Factor of two improvement in radar resolution to reduce errors caused by rain inhomogeneity
- Dual polarization to differentiate between liquid and frozen hydrometeors (TRMM radar has single polarization)
- Doppler capability to obtain vertical motion structure (TRMM radar none)
- Simultaneous doppler/polarization observations to constrain implicit rain ambiguity (TRMM radar makes reflectivity-only observations)
- Cross-track adaptive scan to increase swath coverage (a factor of 3 better than TRMM radar)
- Same frequency as TRMM radar to allow smooth extension and direct comparison of rain data record
- A factor of 2 to 3 mass reduction from TRMM radar



Airborne Demonstrator Precursor

Mechanically scanned, horn fed reflector

TWTA transmitters

Ferrite T/R and polarization switches

Dual-frequency (13.405 and 35.605 Ghz)

Dual-linear Polarization at each frequency

Scan Beam Capability 0-20 Degrees

Match Beamwidths at Each Frequency/Polarization of Operation to Within 25%

Antenna Patterns Sidelobe Level < -25 dB

VSWR < 1.6

Bandwidth at Each Frequency/Polarization > 10 MHz

PR-2 Airborne Payoff

PR-2 (airborne) was selected to fly on the DC-8 during the CAMEX-4, a multi-agency field campaign to study hurricanes in August 2001.

It will provide measurements of rain rate.

PR-2 (airborne) will improve measurement capability over current systems

- Dual-frequency (14/35 GHz) to improve dynamic range and sensitivity on rain measurements
- Factor of two improvement in radar resolution to reduce errors caused by rain inhomogeneity
- Dual polarization to differentiate between liquid and frozen hydrometeors
- Doppler capability to obtain vertical motion structure
- Cross-track adaptive scan over ±37° to increase swath coverage

PR-2 (airborne) is a precursor demonstration of capability for GPM/ generation 2.

HAMSR: High Altitude MMIC Sounding Radiometer

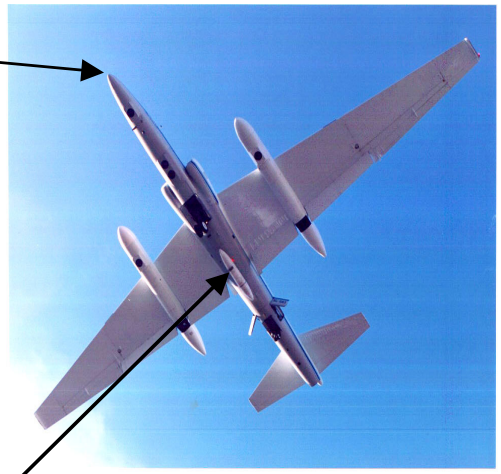
Objectives

Build millimeter-wave atmospheric sounder using new miniature technology

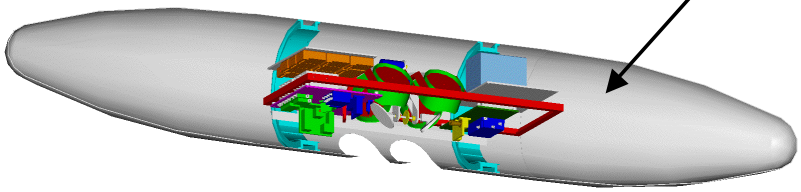
- Temperature and water vapor sounding capabilities (54, 118 & 183 GHz)
- First MMIC based atmospheric sounder (54 & 118 GHz)
- Reduced size/mass/power (fraction of AMSU)

Operate prototype in the field on board ER-2

Revised HAMSR Mounting in ER2 Nose



Original concept HAMSR Mounting in ER2 Fuselage Pod



HAMSR Payoff

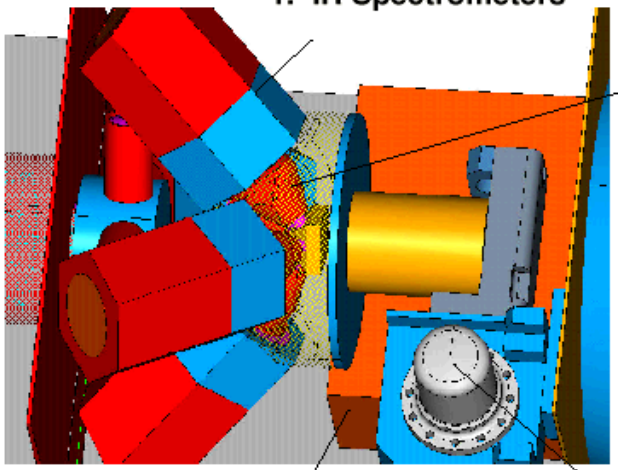
HAMSR was selected to fly on the NASA ER-2 during the CAMEX-4, a multi-agency field campaign to study hurricanes in August 2001.

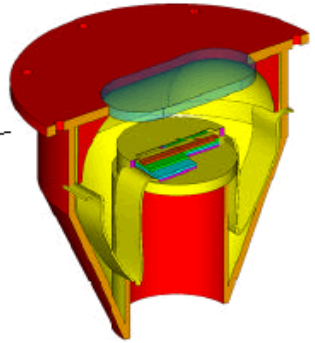
It will provide core measurements of temperature, humidity, liquid water profiles as well as scattering from rain and ice.

HAMSR is the first sounder to use new miniature MMIC technology, developed by NASA and integrated into a functional instrument under IIP.

HAMSR is the only instrument to combine this measurement suite in a single, small package

The Spaceborne Infrared Atmospheric Sounder SIRAS for EOS Follow-on Missions





	AIRS	SIRAS-L
Size	0.9 m^3	0.13 m^3
Mass	140kg	60 kg
Power	220W	100W
Rate	1.42 Mbps	1.42 Mbps

Capabilities

- 15km Pixels at LEO to match AIRS/AMSU
- 10km at GEO with AIRS Performance with 4" Telescope
- 100 m at 400 km Orbit for Hyperspectral Imager
- 30 m at 400 km possible with 12" Telescope

SIRAS Payoff

SIRAS under consideration in several future ESE missions

Near Term (2002-2005 Start)

- ESSP for Carbon Dioxide Measurement (SIRAS-C)
  - Recent analyses have found that SIRAS-C has real potential for accurate measurements of CO_2 in the low to mid troposphere.
- Follow-on LEO Atmospheric Sounder (NPOESS or NASA)
  - CrIS (NPOESS) does not offer the range, sensitivity or resolution of AIRS (or SIRAS) and may lead to discontent amongst the user community
- ESSP for Urban Environmental Monitoring
  - Recent studies have shown that SIRAS used as an atmospheric correction module can greatly increase the temperature accuracy of future high spatial resolution thermal imagers (e.g. ASTER follow-on).

Long Term (2006-2010 Start)

- Follow-on GEO Atmospheric Sounder
  - GSFC has expressed interest in SIRAS technology for the Advanced Baseline Sounder due to the use of no moving parts and high radiometric sensitivity.
  - A Phase B study exercise is to commence in summer of 2001